Dissertation

at

A report on

Factors impacting patient outcomes associated with the use of Emergency medical services operating in urban vs Rural areas

by

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Under the guidance of

Manish Priyadarshi

Post Graduate Diploma in Hospital and Health Management

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International Institute of Health Management Research

New Delhi

DTDHI Health India Private Limited

The certificate is awarded to

Dr AMIT KUMAR YADAV

In recognition of having successfully completed his internship in the department of

OPERATIONS

And has successfully completed his project on

Factors impacting patient outcomes associated with use of Emergency medical services operating in urban vs rural areas

He comes across as a committed, sincere and diligent person who has a strong drive and zeal for learning

We wish him all the best for his future endeavors

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that Dr. Amit kumar yadav student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health Management Research, New Delhi has undergone internship training at DaytoDay Health from 10th feb 2020 to 10th may

The Candidate has successfully carried out the study designated to him during internship training and his/her approach to the study has been sincere, scientific and analytical. The Internship is in fulfilment of the course requirements.

I wish him all success in all his/her future endeavours.

Dr Pradeep K Panda
Dean, Academics and Student Affairs
IIHMR, New Delhi

Mentor
IIHMR, New Delhi

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I am thankful to and fortunate enough to get constant encouragement, support, and guidance from all which helped us in successfully completing my project work.

Dr. Amit Kumar Yadav
(Pg/18/097)

Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Amit Kumar Yadav** a graduate student of the **Post- Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision. He is submitting this dissertation titled "Factors impacting patient outcomes associated with use of emergency medical services operating in urban versus rural areas" at "DaytoDay Health India" in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management.**

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Institute Mentor	Organization Mentor
Manish Priyadarshi	Aditi Shankar
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Section -1 Organisation Profile

daytoday

END TO END PATIENT ENGAGEMENT SOLUTIONS

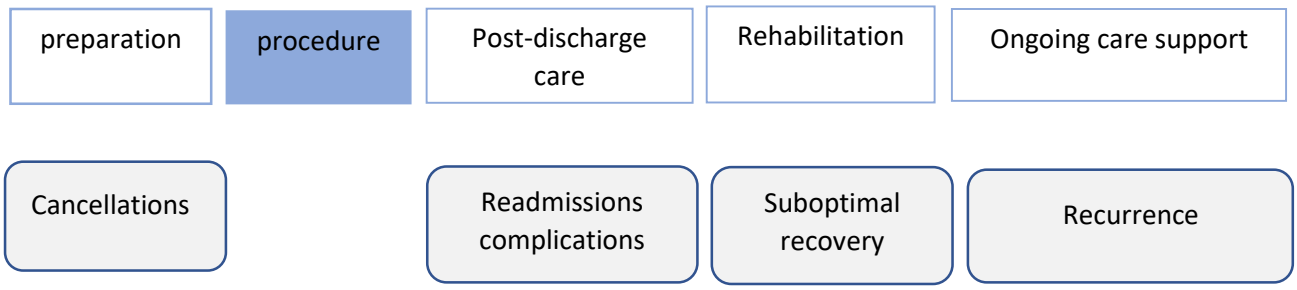
MIT fuse IAP · MIT delta v · MARTIN TRUST CENTER FOR MIT ENTREPRENEURSHIP · MIT Sandbox · LEGATUM · MIT IDEAS

POWERED BY PARTNERING WITH Fortis

Mission

To become the gold standard in patient-centred care

Because the majority of care journeys reach beyond hospital walls, patients are often inadequately supported in the preparation and recovery phases that will determine the quality of their treatment outcomes. DayToDay HealthTM equips hospitals to unleash the full potential of their care teams to transform patients' lives.



*source- Daytoday health

END TO END PATIENT ENGAGEMENT SOLUTIONS

Pre- Procedure care

Patients are guided through all the tests, tasks, information and mental preparation they need to be fully ready for their procedure.

Remote Care

Treatment-specific assessments and symptom monitoring equip caregiving teams to manage patients who have returned to their lives beyond hospital walls.

Post- procedure care

After patients are discharged, guiding them on a daily, step by step basis, with nurses checking in to answer questions and look out for any concerning symptoms.

Psychological Support

Guiding patients through condition specific support modules such as mindfulness and breathing exercises, and provide compassionate and open support through our nurse care coaches.

Seamless Registration

Onboarding patients with minimal disruption to hospital workflow and manage care journeys in step with provider- side updates.

END TO END PATIENT ENGAGEMENT SOLUTIONS

Rehabilitation

When patients need to follow a rehabilitative protocol such as physiotherapy or cardiac rehab, we continue to support them with tools tailored to their care journey needs.

PERSONALIZED ACUTE CARE MANAGEMENT

Daytoday health's differentiated approach includes three service pillars backed by products that reinforce each other.

Three pillars of Daytoday health

CONTENT

- Consumer friendly

  Patients and their families can access our resource library tailored for them.

- Control & transparency

  Patients can be an 'Active' contributor in their own care by accessing their daily progress reports

END TO END PATIENT ENGAGEMENT SOLUTIONS

CONTEXT

- Patient centric

  Assessments captured via our **Patient Management System** distil information into patient insights.

COACHING

- Complete clinical expertise

  Virtual care team comprises of **well-trained** nurses, physiotherapists, pharmacists, and psychologists to hand-hold patients through the care journey

- High touch

  Care team handles patient questions, directing urgent needs to the hospital team via **chat, calls, and home visits.**

FEATURES

a. **Critical metrics tracking**
   Hospitals need patient status updates to give the best care possible. But capturing these updates can become an administrative burden. By automating follow-ups, our platform streamlines the collection process and reduces the variability of patient-reported outcomes.

b. **Holistic care plans and communication**
   Three service pillars – expert coaching, dynamic content and data- driven personalization- relive patient anxiety by ensuring that their questions and concerns are adressed. They also hospital staff become freer to focus on things that matters most and they help ensure patients arrive at visits informed and confident, having done all the right things.

c. Expert care coaches

Provide clinical nurse specialists trained for the procedure or treatment patients are undergoing. They are the first line of contact for questions and concerns, offering compassionate support, and direct urgent needs to hospital staff when necessary.

d. Dynamic patient journeys

The content is designed to guide patients through scheduled daily tasks and longer courses of mental and physical building. Rich interactive media, ground in behavioral psychology methods and practices provide a patient experience well beyond static information.

DEPARTMENTS

- Data analytics
- Operations
- Marketing
- Product development
- Sales
- Clinical operations
- Human resource
- Information technology

SWOT ANALYSIS OF DAYTODAY HEALTH

STRENGTH

- Innovative Business Model
- Well - funded
- Patient Centric
- High patient compliance rate
- Integration of healthcare delivery system our USP

- Reduction in patient's healthcare expense
- Strong Leadership, Skilled Human Resource, make Good Team

WEAKNESSES

- Limited Service Lines
- Availability of app only in English
- Resistance to technology by doctors
- IoT devices are not supported
- Lack of streamlined process
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- Health care, one of the most regulated industry.

OPPORTUNITIES

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- Lack of awareness among people and an absence of consumer-driven demand
- Well established home-healthcare market

END TO END PATIENT ENGAGEMENT SOLUTIONS

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- Technological advancement
- Legal challenges
- Forward or backward integration by existing players in market

Section -2 Dissertation Report

2.1 INTRODUCTION

In serious life-threatening situations a fast ambulance response is required. Late arrivals can have a serious impact on the well-being of the patients, and can also have consequences regarding policy making. Ambulance service providers (ASPs) face a broad range of challenges in order to realize fast response times. While remote rural areas face the challenge to provide care for an aging population that decreases in size, urban areas are making efforts to cope with the increasing demand on the number of calls. In the meantime, regional characteristics are subject to constant change in regulations, changes in hospital openings, and alterations in the ambulance fleet's composition and size

Traumatic injuries are one of the leading causes of death around the world, with the World Health Organization (WHO) noting that the estimated five million traumatic injury-related deaths annually were equivalent to the combined deaths associated with human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), malaria and tuberculosis. It is known that one of the most significant factors affecting health outcomes in trauma patients is time, with the period before commencement of healthcare support and then while transferring a patient from the original incident site to a health service considered critical to reducing mortality and improving recovery for the individual. The concept of a 'golden hour', the length of time immediately after the trauma and until care is provided, is often used as a key performance measure for emergency medical care, although the validity of the implied '60 minutes' timeframe is open to question. However, the potential magnitude of any gap between low-, middle- and high-income countries, and particularly in relation to rural versus urban differences, has not been comprehensively explored. EMS(Emergency medical service) provide health assistance to patients affected by sudden illness or injury and are often the first line of care responders for individuals during medical emergencies. The roles of EMS include providing primary on-site emergency healthcare, ongoing care during transportation from the location, and then the transfer of care upon arrival at the nearest appropriate receiving healthcare facility. As an example of the importance of an effective EMS, it has been estimated that 74% of ischemic heart disease mortality occurs either outside of, or prior to, a patient's arrival at a hospital, and therefore, that any prehospital care provided by support options plays a vital role in increasing survival rates. Similarly, patients with coronary artery diseases and trauma were found to have higher levels of preventable deaths due to the delayed receipt of prehospital care by an EMS. Factors that may limit the ability and capacity of an EMS to provide appropriate prehospital care include the geography of the area, equipment availability and training in life-saving protocols. The association between response time interval, the period between notification of an incident and EMS arriving on the scene, and improved survival rates has been strongly established and has subsequently become an international standard for EMS, particularly in urban settings. Prehospital intervals refer to the time between an incident occurring and the patient arrival at the nearest appropriate health facility. As a consequence of the significant differences that are inherent both within and between different countries, attempts to define target goals for prehospital intervals have remained difficult. One recommendation for a prehospital interval time noted that patients should receive basic life support within four min and advanced life support within eight min of a traumatic event, but this goal was recognised as being impossible to achieve in some rural locations. A National Association of EMS Physicians position paper reported that response and transport time intervals vary according to the region and thus should

be locally determined but offered no definitive standards for EMS to meet in rural or urban areas. Therefore, establishing the association between prehospital interval and mortality outcomes is complicated, as in some countries, paramedics are supported by medical professionals on-site in starting life-saving treatment before transfer, while in other countries, only paramedics attend the trauma site and work towards immediately transferring the patient to a hospital.

. Urban–rural difference in the performance of EMS in achieving better patient outcomes is an issue of limited but ongoing investigation in high-income countries. It was found that cardiac patients in an urban area had significantly higher survival rates than patients in rural areas; this difference was predominantly ascribed to the time differential in EMS arrival on-scene. The purpose of this current study was to examine the literature base regarding urban versus rural differences in EMS in relation to patient outcomes. Specifically, the overall goal was a focus on the identification and review of all such research in low- and lower-middle-income countries, as it has been noted by the United Nations (UN) that, while nearly half the world's population live outside of a metropolitan area, this proportion is generally even larger in countries with less developed infrastructure . However, it was recognised that the existing literature in this field might be limited, and therefore, it was predicted likely to have to encompass findings on urban versus rural differences in EMS patient outcomes from all countries. The overarching review question was defined as "What factors differentiate urban and rural EMS and contribute to differences in patient outcomes in low- and lower-middle-income countries.

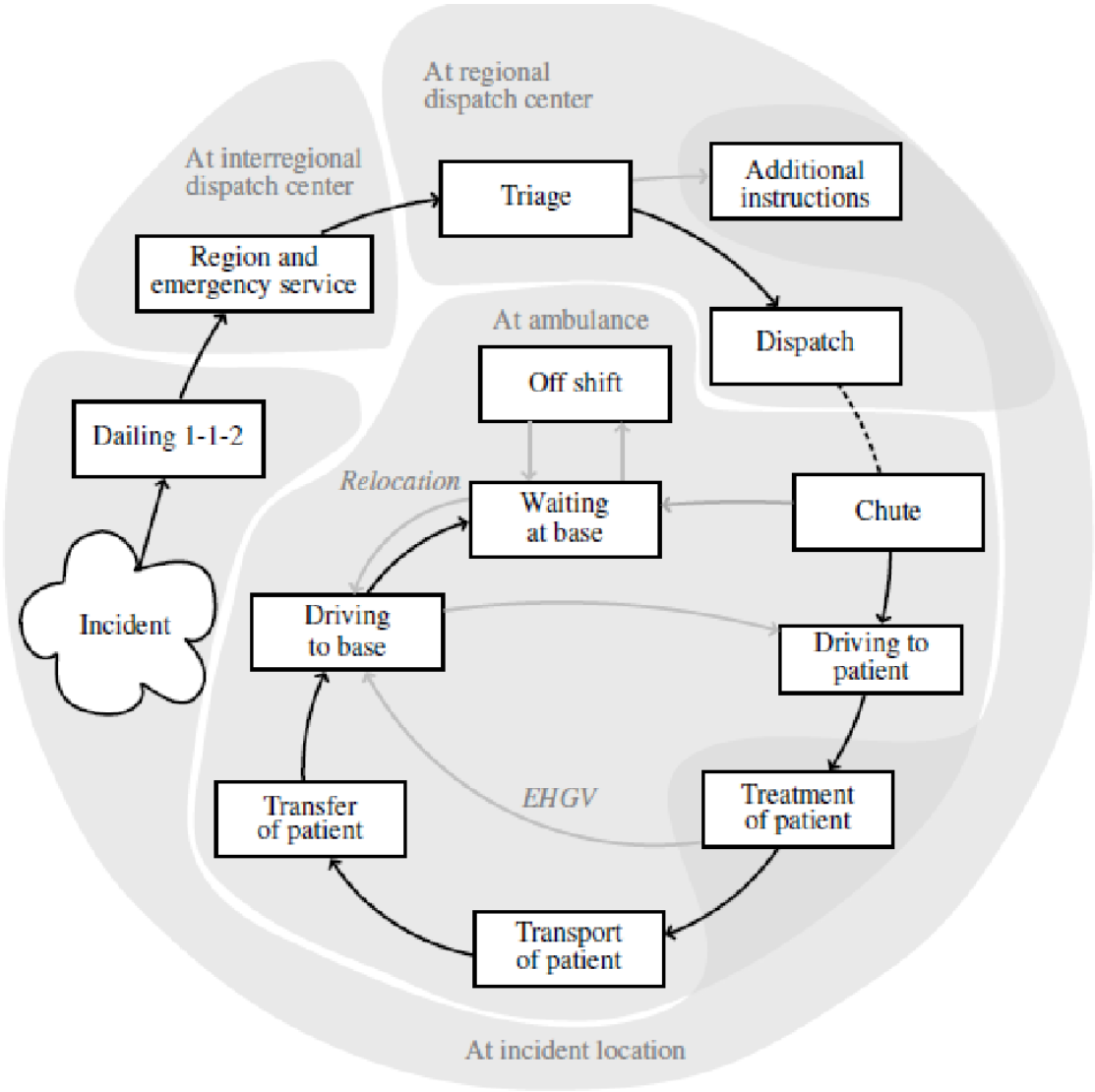
2.2 Regions

Ambulance care is spatially partitioned into multiple regions in the fast majority of countries; each region has an ambulance fleet and is coordinated by one
dispatch centre.

2.3 Dispatch centres

A request for ambulance care starts by an applicant at an incident location who believes that professional medical aid from emergency medical technicians is required. In most countries, a request for EMS is executed by calling a nation-wide emergency telephone number, such as 1-0-8 or 9-1-1. The request is answered by a call centre agent. Depending on the country's system, this call centre handles the entire request, or the agent determines the region and emergency service one needs, where after the request is forwarded to the correct regional call centre. This may be a general call centre for emergency services, or a specific medical or EMS call centre. Medical professionals and other emergency services have a separate telephone number that directly connects them to the right dispatcher. The call centre is called the dispatch centre in the case it is the last of multiple call centres that an applicant speaks to in order to get access to ambulance care. The dispatch centre has the task to determine the level of the injury in the so-called triage procedure, that is the assignment of degrees of urgency to wounds through performing a questionnaire. Consequently, an ambulance is sent to incidents only in the case the patient really needs this service. The number of ambulances is limited, and it is important to have an ambulance available for dispatch when needed. If ambulance care is required, i.e., the request for EMS is honoured, an available ambulance is sent to the incident during the dispatch procedure, and care is provided when the ambulance arrives at the incident location. To bridge

the time gap until the medical professionals, arrive, the dispatch centre may provide the applicant with additional instructions on first aid actions. Reanimation instructions are clear example of these additional instructions to an applicant who has no medical know-how. If the patient needs hospital care, transportation to a hospital is provided. The dispatch center is in control when it comes to coordination of the EMS services. EMS call centre agents communicate with hospitals and ambulance teams.



*source-T. Andersson and P. Värbrand. “Decision Support Tools for Ambulance Dispatch and Relocation”. Journal of the Operational Research Society. Special Issue on OR in Health.

Fig 2.1 The ambulance service process as it usually takes place consists of various steps: at the incident, in the dispatch centres, and at the ambulance.

2.4 Urgency levels

Each honoured call is assigned an urgency level. The Dutch EMS system distinguishes three levels: A1, A2, and B.A1 - An urgent call with an acute threat to the patient’s life. Vital functions of the patient are not or rarely present, or cannot be determined through the

telephone. The EMS vehicle uses optical and visual signals and tries to get to the patient as soon as possible. Examples: heart attack, reanimation or serious traffic incidents.

A2 - A patient's life is not under direct threat, but there might be serious injuries. The EMS vehicle may use optical and visual signals if the EMS personnel have discussed this with the dispatch centre, but this only happens on rare occasions. Examples: a broken leg or a general practitioner asks for transportation to a hospital.

B- A non-urgent call in which the patient must be transported within a given predetermined time interval. A typical B-call exists of transferring a seriously ill person from one hospital to another, because this hospital is specialized in the patient's condition. When a seriously ill person receives a scheduled transport from an EMS vehicle to his or her home, it will be classified as a B-call as well. Calls with this urgency level are commonly referred to as ordered transportations. A major difference between calls that are labelled with urgencies A1 and A2 on the one hand and calls with urgency B on the other is that the occurrence of calls with A1 or A2 urgency are not known beforehand, while calls with urgency B can be planned.

2.5 The ambulance service process

Once a dispatch centre agent has determined the urgency and incident location, the search for the best ambulance to dispatch starts. Usually, this is the ambulance that can reach the incident location in minimal time, although in practice many other variables play a role, such as the vehicle transportation capabilities and the remaining shift time. Not all vehicle types can attend any incident type. For instance, in a fleet with multiple ambulance types the cheaper to operate basic life support ambulances can only attend ordered transportations. When a shift is about to end, or when emergency medical technicians (EMTs) just have attended a severe incident, a dispatcher can decide to send another ambulance that travels a bit longer, but is better for the overall fleet's morale. When the pagers of the EMTs are activated at dispatch, some time passes before the ambulance starts moving, since it takes time to get into the vehicle. This time period is called the *chute time*. The entire duration of a call entering the system until the ambulance starts moving is called the *pre-trip delay*.
Next, the EMTs *drive to the patient*. When the ambulance arrives at the incident location, the response time is known. The response time is defined as the length of the time interval between the moment that the call enters the queue at the call centre agent until the moment the EMS vehicle arrives at the incident location. After driving to the incident follows the *treatment of the patient*. In some cases, the patient is treated at the incident location, after which the ambulance returns to the base location. In other cases, the patient is transported to the hospital. In some countries a patient is always transported to the hospital, either because ASPs are paid per transport, or because the country's legislation states that the ASP must provide fastest means to the hospital and the medical professionals start treatment there instead of at the incident location. Literature is not unambiguous about whether 'stay and treat'.
After the transport of the patient to the destination follows the transfer of the patient that usually bridges pre-hospital care with hospital care. Sometimes the transfer time is referred to as the turn-around time. After finishing up the transfer, the ambulance is available for handling the next incident. If there is no nearby patient to attend, the last stage of the ambulance trip consists of driving back to its base location. Here it waits for a new call, or until the shift ends.
For basic life support (BLS) transport, and occasionally for advanced life support (ALS) transport, it is possible that the incident location is a hospital. In that case, the destination may be another hospital or a home address. This can happen if a patient is brought home after a day

treatment, or when another hospital is specialized in the patient's medical condition. Since our primary focus is on ALS transport with random arrivals, we keep respecting the destination mentioned before, even if the patient's destination is not a hospital.

Response times

The public perception with respect to ambulance care dictates that every second counts. Throughout the world, the response times are used as a proxy for the quality ambulance care. Multiple times questions have been asked about the quality and origins of this proxy, which is the motivation for this section. Does every second count?
The key performance indicator (KPI) is the fraction of late arrivals for potentially life-threatening incidents; that is, the number of calls that exceed a given response time threshold divided by the total number of calls in the system.
Larger countries differentiate response times and have other KPIs for urban and rural. Too many late arrivals can result in a penalty or can have an adverse impact on the reputation of the EMS provider. Traditionally, this KPI is calculated for an entire ambulance region, over a whole year. But is there a better alternative? Scientific literature provides some insight. Articles show that there are only a few validated indicators of the effectiveness and quality, which mostly relate to patient satisfaction and general system processes, each providing an indirect measure of quality which is difficult to relate to outcomes in patient care. Two other studies conclude that no statistical evidence can be found that short responses increase the probability of survival. Especially in the field of *heart attacks* fast responses do save lives. Furthermore, there is no chance of survival if the response time exceeds 30 minutes.
The one-year survival rate increases even more if bystanders or police officers provide external cardiac massage and artificial respiration, also known as CPR. Also, for roadside incidents it is shown that a response time reduction from 25 minutes to 15 minutes causes a third fewer mortalities Finally, indicates that response times, amongst others, is a valid indicator of the quality of care for cardiac arrests. Based on the heart attack survival curves, ambulances location models are created that maximize the probability of survival. As a result, it is shown that maximizing response time thresholds can actually serve as effective proxies for patient survival if this limit is set to seven or eight minutes.

Ambulance (ALS VS BLS)

> An **ambulance** is a medically equipped vehicle which transports patients to treatment facilities, such as hospitals.[1] In some instances, out-of-hospital medical care is provided to the patient. Ambulances are used to respond to medical emergencies by emergency medical services. For this purpose, they are generally equipped with flashing warning lights and sirens. They can rapidly transport paramedics and other first responders to the scene, carry equipment for administering emergency care and transport patients to hospital or other definitive care. Most ambulances use a design based on vans or pick up vans. Others take the form of motorcycles, cars, buses, aircraft and boats.

ALS- Advance life support ambulance for critical patients

The Advance life support ambulance has a paramedic on board, along with an Emergency medical technician. The ambulance is equipped with airway support equipment, Cardiac life support, cardiac monitors as well as glucose testing device. The ALS ambulance also carries emergency medications on board. The patient in an ALS ambulance require a higher level of medical monitoring and include those who need continuous IV drips, those on chronic ventilator, and those who require cardiac monitoring.

The paramedics and EMTs who staff the Advance life support ambulances have a higher level of training than those who operate Basic life support ambulances. Due to their advance training, ALS ambulance personnel are allowed to start IVs, medications and give injections to stabilize patient on the way to a nearby hospital.

BLS- Basic life support ambulance

Staffed with paramedic, Basic life support transport for patients who are not critical, transferred to sub-acute or who are discharged to home care, psychiatric patients and other non-emergency medical transportation.

The personnel of BLS ambulance is not allowed to do any procedures that break the skin of the patients, which includes giving injections, administering medications, starting an IV or any necessary medical process including cardiac monitoring

3.OBJECTIVE:

- To determine the factors that differentiate the rural and urban emergency services

- To assess the factors that contribute to differences in patient outcomes in lower middle-income countries.

4.Methodology:

Definition of Rural Versus Urban Prior to commencement of the systematic review, the definition of what constituted ‘rural’ versus ‘urban’ needed to be determined. Throughout both the literature base and government sites, definitions of rural and urban are inconsistent and vary dramatically from one country to another, and even within countries. The United Nations Statistics Division has recognised this problem and argued that “the distinction between urban and rural population is not amenable to a single definition applicable to all countries.

For this reason, each country should decide which areas are to be classified as urban and which as rural, in accordance with their own circumstances”. The decision was made to follow the definition used in each separate research paper, and it is acknowledged that this would result in differences of definition across the entirety of the articles. However, it was felt that this compromise was the most appropriate solution as each paper would have used the relevant definition for that specific location. Any attempt to re-analyse all of the available data to conform to one definition, if such a definition could even be agreed upon, was deemed beyond.

4.2 Literature Review Methodology

Building your research on and relating it to existing knowledge is the building block of all academic research activities, regardless of discipline. Therefore, to do so accurately should be a priority for all academics.

However, this task has become increasingly complex. Knowledge production within the field of business research is accelerating at a tremendous speed while at the same time remaining fragmented and interdisciplinary.

This makes it hard to keep up with state-of-the-art research and to be at the forefront, as well as to assess the collective evidence in a particular research area. This is why the literature review as a research method is more relevant than ever. A literature review can broadly be described as a more or less systematic way of collecting and synthesizing previous research

11 articles were reviewed and evaluated and a semi systematic review was done. Also to determine whether any of these studies should be excluded on the basis of quality the Critical Appraisal Skills Programme (CASP) model was employed. This assessment process examined each paper on three broad issues: Are the results of the study valid? What are the results? and Will the results help locally? and each study could get a maximum score of 12

.

Author/year	Study Title	Study Design	Setting and age	Patient age demographics	Study sample	Outcomes of interest	CASP Grade
Stripe and Suaman 1991	A rural-urban comparison of prehospital emergency medical services in Nebraska	Prospective study	The USA. 1988–1989	Not specified	Patients attending emergency medical services	The rural ambulance provided more services than an urban ambulance.	5/12
Gonzalez et al. 2006	Increased Mortality in Rural Vehicular Trauma: Identifying Contributing Factors Through Data Linkage	Retrospective analysis	The USA 2001–2003	Not specified	6443 patients with crash injuries	Mortality rates were 4.2% and 2.1% in rural and urban respectively (p = 0.0001).	6/12
Herlitz et al. 2006	Characteristics and outcome of patients with acute chest pain about the use of ambulances in an urban and a rural area	Cross-sectional study	Sweden 1996–1997	71 ± 15/59 ± 17	Patients with acute chest pain	The Mortality rate was 41.8% among those transported by ambulance and 15.8% among those transported by other means	7/12
Jennings et al. 2006	Out-of-hospital cardiac arrest in Victoria: Rural and urban outcomes	Retrospective case series	Australia 2002 to 2003	68.4 ± 14.4/65.2 ± 13.4	1790 patients with bystander-witnessed cardiac arrest	Rural areas had more bystander cardiopulmonary resuscitation than urban areas. Urban patients with bystander-witnessed cardiac arrest were more likely to discharge from hospital alive than rural patients.	5/12
Moore et al. 2008	The Northern Ireland Public Access Defibrillation (NIPAD)	Prospective before and after the intervention,	Northern Ireland 2004–2006	67.9 (15.1)	Patients with out-of-hospital cardiac arrests	In the urban areas, rates of survival were 5.1% in 2004 and 1.4% from	8/12

	study: Effectiveness in urban and rural populations	population study				2005 to 2006. In the rural areas, survival rates were 2.5% in 2004 and 3.5% in 2005–2006.	
Gonzalez et al. 2009	Does increased emergency medical services prehospital time affect patient mortality in rural motor vehicle crashes?	Retrospective analysis	The USA 2001–2002	Not specified	45,763 crashed patients	Rural settings had a higher mortality rate than urban settings. 1.78% in rural settings versus 0.90% in urban settings ($p < 0.0001$).	7/12
Mihalicz et al. 2010	Urban vs. rural pediatric trauma in Alberta: Where can we focus on prevention?	Retrospective analysis	USA 1996–2006	11 (0–17)	2660 paediatric patients with major trauma	Urban patients had a higher rate of mortality than rural ones (13.0% vs. 10.5%; $p = 0.05$).	8/12
Bhuyan et al. 2013	Rural-urban differences in acute myocardial infarction mortality: Evidence from Nebraska	Retrospective analysis	The USA 2005–2009 and 2011	15 to 85+	Patients with acute myocardial infarction	Urban areas had a lower mortality rate than patients in rural areas.	8/12
Raatiniemi et al. 2015	Short-term outcome and differences between rural and urban trauma patients treated by mobile intensive care units in Northern Finland: A retrospective analysis	Retrospective analysis	Finland 2012–2013	33 (20–55)	472 traumatic patients	Mortality within 30-day was 23.9% in urban and 13.3% in rural.	8/12

Beck et al. 2017	Resuscitation attempts and duration in the traumatic out-of-hospital cardiac arrest	Retrospective analysis	Australia 2008–2014	Median = 44 years	2334 patients with traumatic out-of-hospital cardiac arrest	Arrests occurring in urban regions had significantly higher odds of attempted resuscitation relative to those in rural regions	8/12
Mathiesen et al. 2018	Effects of modifiable prehospital factors on survival after out-of-hospital cardiac arrest in rural versus urban areas	Prospective analysis	Norway. 2006–2014	Urban = 70 (58–81), rural = 69 (56–80)	1138 patients with out-of-hospital cardiac arrest	Urban patients had higher survival rates than urban patients.	9/12

4.3 Limitations of This Review

The current study has some limitations that may limit the generalisability of the findings.

- Firstly, while the goal was to focus on urban and rural differences specifically in lower- and lower-middle-income countries, there was simply not enough research to support this approach. Therefore, articles from anywhere in the world were included in the final review. This has meant that there are considerable variations in both geographical diversity and population bases in the included studies.
- Secondly, the inherent differences in care delivery across a wide range of diverse countries and settings made global averages difficult to determine for any process of comparison.
- Thirdly, as noted, there was an absence of uniformity in the reporting of prehospital care time. These data variations made comparing and compiling the quality of included studies challenging.

5 Results:

The following Results section is organised by key themes arising from analysis of the 11 articles.

5.1. Prehospital Time

Four studies reported on prehospital time interval. The results showed that prehospital time was significantly shorter in urban locations than in rural areas. Gonzalez et al. reported that prehospital time in rural locations was 42.0 min, while it was 24.8 min in urban areas . Nordberg et al. showed that median time to arrival varied between 0.8 to 3.2 min in urban and rural areas but that rural areas had longer arrival times. Raatiniemi et al. noted that rural areas had longer prehospital times and also noted, not surprisingly, that there were longer geographic distances to travel than urban areas.

5.2. Response Time

Differences between rural and urban areas in terms of response time were found across nine studies. Moore et al. reported that interventions in the urban areas were associated with a significantly lower response time than the rural areas. Gonzalez et al. reported a response time of 13.9 min (rural) vs. 11.2 min (urban) ($p < 0.0002$), and this resulted in increased mortality rates in the rural settings. The study by Gonzalez et al. found mean response times of 10.67 versus 6.50 min in rural and urban settings, respectively ($p < 0.0001$).

5.3. On-scene Time

Three studies reported on on-scene time—the period between arrival at the location and either the resolution of the issue or transportation to another site commencing. These studies argued that on-scene time was significantly shorter in urban than rural settings. Gonzalez et al. reported that mean rural EMS time on scene was 16.1 min, which was significantly higher than for urban settings (11.6 min). Gonzalez et al. noted that the EMS scene time in urban settings was 10.83 min, versus 18.87 min for rural settings ($p < 0.0001$).

5.4. Transfer Rates

Two studies reported on transfer rates, which is the proportion of patients who required transportation from the scene to a health facility. Jennings et al. 2006 reported that rural areas had longer transfer distances and higher transfer rates (3.2% vs. 2.7%). This finding was in contrast to the results of Bhuyan et al. 2013, who had found that urban and rural emergency departments showed similar transfer rates.

5.5. Transport Time

Three studies reported on transport time—the period for transportation from the scene of the incident to the nearest appropriate health facility—and they showed significantly shorter transport in urban than rural settings. Mathiesen et al. found that mean transport times to definitive care were 59 min in urban settings versus 11.6 h in rural settings ($p < 0.0001$), although it is worth noting that a possible increase in the usage of emergency air services in recent years in Western Australia may have at least partially reduced this extremely large difference. Gonzalez et al. noted a mean transport time was 12.45 min in rural versus 7.43 min in urban areas ($p < 0.0001$). Beck et al reported that transport times were decreased in suburban sites compared to rural sites.

5.6. Survival Rates

Five studies reported that EMS patients living in urban areas had higher survival rates than those in rural areas. A study by Park et al. showed that good neurological recovery was demonstrated in 1.6% versus 6.8% of the patients in rural and urban areas, respectively ($p < 0.01$). Mathiesen et al. reported that urban patients had higher survival chance to hospitals admission (odds ratio: 1.58, 95% CI 1.11–2.26, $p = 0.012$) than rural patients. Bhuyan et al. reported that patients in urban areas had a lower risk of death from acute myocardial infarction than patients in rural areas. Jennings et al. and Ro et al. also showed higher survival rates in urban than in rural areas. A study by Raatiniemi et al. reported that mortality within 30 days was 23.9% and 13.3% in urban and rural settings, respectively. Other studies showed that urban and rural EMS were comparable regarding their survival rates

6. Discussion:

The purpose of the current study was to investigate the factors that lead to differences between EMS in rural and urban areas, and specifically in relation to patient outcomes. Initially, the goal was to examine any potential differences solely within low- and lower-middle-income countries . However, it became clear that the literature base was not sufficient to support this approach, and therefore, research from all countries was included. The results indicated some reasonably consistent observed differences between rural and urban EMS. Generally, urban EMS were associated with faster response time, less on-scene time, lower prehospital time intervals, lower transfer rates and reduced transport time, and urban patients had higher survival rates than rural patients. It is acknowledged that, particularly in rural areas, the reasons for any observed differences between rural and urban areas are often complicated and associated with multilevel problems, and there was considerable diversity in the results between countries.

6.1. Response Time

The results showed that, generally, urban areas had a shorter response time than rural areas. This is not surprising, as due primarily to geographic distance, EMS simply take substantially longer to arrive on the scene in rural areas. The response time interval is dependent on the distance to the incident and the maximal speed at which ambulances can safely travel, including roadway conditions and traffic. A differential of nearly 50% was noted for response times between rural and urban areas, identifying that the average response time should not exceed eight min in urban regions and fifteen min in rural regions, while the third quartile of response time should be no more than 12 min in urban regions and 20 min in rural regions.

6.2. On-Scene Time

While disparities regarding response time are somewhat understandable as a consequence of geographic distance, the results showed that the on-scene time was also generally shorter in urban than in rural locations. The reasons for this difference are not as clear-cut as with response time. It is known that on-scene time is affected by the choice of the initial stabilising method, the number of responders and the time required for safely preparing the patient for transport. Other issues that were found to prolong on-scene time included increasing illness severity, a requirement for use of advanced intravenous devices, the mode of transport and complexity of traumatic cases .However, these identified factors do not completely explain why there should be the observed differences between rural and urban locations.

6.3. Transport Time Interval

As with response time, geographic distribution naturally also plays a vital role in the transport time interval. The results indicated that rural transport times were significantly longer than urban transport times. Distance is clearly one of the primary factors leading to this finding; however, other noted issues include the available transport options (e.g., air services were available to supplement road services), the road conditions, and traffic congestion. The increasing use of air transport (i.e., helicopters, planes, etc.) in rural and remote areas has potential to decrease this difference, but this solution is both expensive and reliant on additional training and resources that are not viable in many areas of the world.

6.4. Survival Rates

The reviewed articles indicated that patients living in rural areas had lower survival rates from equivalent conditions when compared to those living in urban areas. Many of the issues associated with this differential in survival rates have been outlined above, with it argued that the difference is primarily due to the increased time taken for an EMS to arrive at the scene. Reducing the time to receiving support from an emergency department cardiopulmonary resuscitation (CPR) team was shown to increase survival rates , while increased time to commencement of advanced cardiac life support was associated with a 39% reduction in survival rates in rural areas . These differences may partially explain observed variations in survival rates between urban and rural patients.

7. Conclusions

- This review of the available literature indicates that EMS in urban areas are associated with lower prehospital time, response time, on-scene time and transport time in comparison to EMS in rural areas. The research base also indicated that survival rates were higher for patients living in a city location than for those residing in rural areas. However, there is only limited research on these issues, and the findings identified across different countries show considerable discrepancies.
- The review also found that there was almost no research in lower- and lower-middle-income countries, with only one study that reported on this area. The potential for service discrepancies between rural and urban settings is arguably even higher in low-income countries, and as such, the findings of this literature review may not accurately capture the actual level of any problems in many parts of the world.
- It is possible that EMS require additional time on-scene in rural areas as a consequence of the longer response time, but this was not clear, and other unexplored factors could be evident.
- It is recommended that this issue should be subject to specific future consideration, with the level and appropriateness of training of staff, the timely availability of key support services and the severity of patient injury three potential key research foci in this area.
- Further research that specifically examines approaches that will facilitate an improvement in rural areas, be it through changes to emergency medicine facilities, tools, vehicles or personnel, including tailored training, in order to provide a fast and efficient response to emergency situations on-site, is also recommended.

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